DOCUMENT RESUME

ED 354 272 TM 019 562

TITLE	High School Graduate Projections by State: A Review of Projection Accuracy and Methodology. Technical Report.
INSTITUTION	College Entrance Examination Board, New York, N.Y.; Western Interstate Commission for Higher Education, Boulder, Colo.
PUB DATE	Nov 92
NOTE	11p.
AVAILABLE FROM	WICHE Publications, P.O. Drawer P, Boulder, CO 80301-9752 ($7.50 plus $3 shipping and handling).
PUB TYPE	Statistical Data (110) -- Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Cohort Analysis; Comparative Analysis; *Educational Trends; Enrollment Projections; Higher Education; *High School Graduates; High Schools; National Surveys; *Predictive Measurement; *Research Methodology; State Surveys; Statistical Data: Validity
IDENTIFIERS	*Accuracy; Cohort Survival Procedures; Educational Information; Western Interstate Commission for Higher Education

ABSTRACT

In 1979, the Western Interstate Commission for Higher Education (WICHE) began its high school graduates by state projections. The three editions issued since that time have been widely used. This report provides an analysis of the accuracy of the WICHE's projections and an examination of the cohort survival method used to generate the projections. This method assumes that enrollments and graduates can be projected by measuring the survival or transition of birth cohorts into first grade, and then from one grade to the next. The first section of the report compares the WICHE's 1988 projections by state with the number of actual graduates reported through 1990-91 and with projections by the National Center for Education Statistics. The second section discusses the Mean Absolute Percentage Error (MAPE) achieved using the cohort survival method for all 50 states and the District of Columbia. The WICHE's figures have closely followed actual trends in graduation. The 1988 projection series varied less than 1 percent from the actual number of graduates for 1988 and 1989; and 1.5 and 2.3 percent, respectively, for 1990 and 1991. Four tables and one graph complement the discussion. (SLD)

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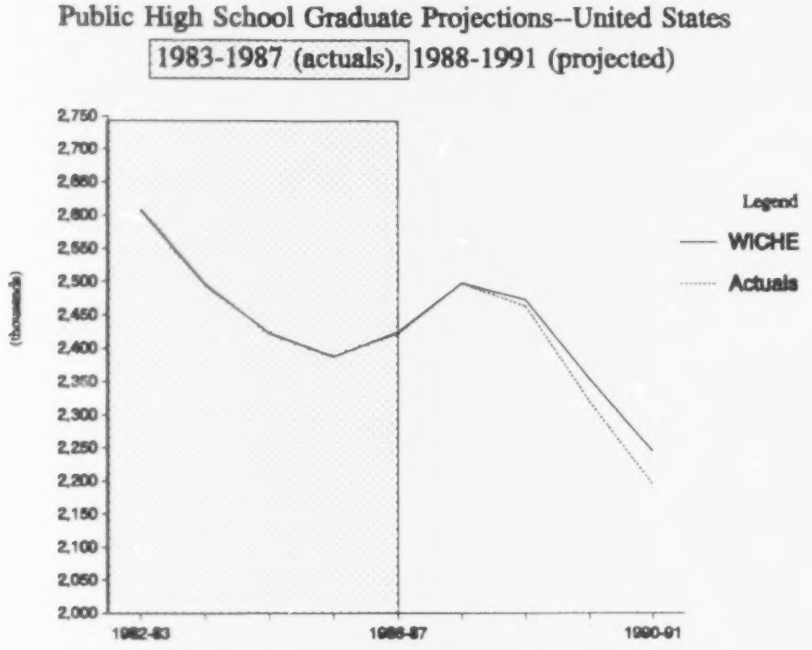
High School Graduate Projections by State:

A Review of Projection Accuracy and Methodology



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Technical Report

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The Western Interstate Commission for Higher Education (WICHE) was established by a compact of the western states to promote and facilitate resource sharing, collaboration, and cooperative planning among those states and their colleges and universities. The 15 member and affiliate states are: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

WICHE's Office of Research and Policy Analysis conducts research and policy analysis on vital issues in higher education and communicates this information and analysis to education and government policymakers. The Office of Research and Policy Analysis maintains the database of historical enrollment and graduate data on which this report is based. Inquiries regarding this report and the high school graduates project in general should be directed to Robin Etter Zúñiga, Research Associate, Office of Research and Policy Analysis, (303) 541-0224.

Additional copies of this report are available from WICHE Publications, P.O. Drawer P, Boulder, CO 80301-9752 for $7.50 each plus a $3 shipping and handling charge.

Published November 1992 by the
Western Interstate Commission for Higher Education
P.O. Drawer P
Boulder, Colorado 80301-9752
Telephone (303) 541-0200
An Affirmative Action/Equal Opportunity Employer
Printed in the United States of America
Publication Number 2A230
50-51-00-5401:5C:11/92:BRMF:2A230

Foreword

Coping with the dramatic increases and decreases in the number of high school graduates during the past 30 years has made planning difficult for secondary school administrators, college and university planners and others who serve the nation's young adult population. In 1979 WICHE, in response to the need for reliable data, began its high school graduate projections by state project. Since 1979, three editions of the high school graduates projection study have been released. These projections are widely used and regarded as a reliable indicator of future trends. This report provides an analysis of the accuracy of WICHE's projections and an examination of the "cohort survival" method used to generate the projections. It is intended both to inform the users of WICHE's high school graduate projections studies about the accuracy of the projections and to test the reliability of the projection methodology. It reflects WICHE's commitment to providing the best data possible to the higher education community.

Robin Etter Zúñiga, research associate in the WICHE Office of Research and Policy Analysis, had primary responsibility for analyzing the data and drafting the report. Several WICHE staff assisted with this project. Kelly Zweifel, senior secretary, and Ginny Golder, research associate, were responsible for collecting recent historical data. Kelly and Diana Vari, research assistant, entered data and helped generate the projection series. Cherie Pedersen, senior secretary, prepared successive drafts of the report.

WICHE gratefully acknowledges the support of our co-publisher, The College Board. We also want to thank the many individuals in state education agencies who supplied the data and answered questions. Without their help, this publication would not have been possible.

Judith I. Gill
Director
Research and Policy Analysis

Western Interstate Commission for Higher Education
Boulder, Colorado
November 1992

Introduction

The size of the nation's high school graduating class has increased and decreased in a roller coaster pattern since the 1970s. The number of graduates reached a peak in the late 1970s, declined steadily through the 1980s and the early 1990s; and is expected to bottom-out in the mid-1990s and increase steadily through the turn of the century. Coping with these dramatic declines and increases in high school graduates requires reliable information and careful planning by secondary school administrators, college and university officials, the military services, employers, and others who are interested in changes in the young adult population. In 1979 the Western Interstate Commission for Higher Education (WICHE), in response to this need, began a regular high school graduate projection study, providing data for each of the 50 states and the District of Columbia. Since 1979 WICHE's projections have been widely used and regarded as a reliable indicator of future trends.

WICHE's third and most recent projection series was released in 1988. It was based on the most current data available in 1987-88, extended the projections to the year 2004, and included estimates of non-public graduates for states which do not collect those data.

The Projection Methodology. WICHE's high school graduate projections are based on a "cohort survival" method. This method assumes that enrollments and graduates can be projected by measuring the "survival" or transition of birth cohorts into first grade and then from one grade level to the next. The relative size of each graduating "cohort" is directly related to the number of births eighteen years before. State education agencies supply historical data on elementary and secondary enrollments and actual high school graduates. Resident live birth data are collected from state vital statistics agencies.

As with all projection techniques, the goal of the cohort survival method is to minimize error. The survival of a given cohort as it progresses through school is affected by a variety of factors (e.g., migration, mortality, transfer from public to private schools, non-promotion, and persistence in high school). Since estimating projection ratios depends on what is known about the past progression of students from one grade to the next, changes in any of these factors, as well as inconsistencies in the data have a significant effect on the accuracy of the projections.

The Test of Accuracy. This report provides an analysis of the accuracy of WICHE's projections by examining the accuracy of WICHE's 1988 projections of public high school graduates by state, and evaluating the reliability of the projection methodology.

The report is divided into two sections. The first section compares WICHE's 1988 public high school graduate projections by state with the number of actual graduates from public schools reported through 1990-91 (the last year for which actual data are available)

and with the 1989 edition of the National Center for Education Statistics (NCES)[1] high school graduate projections by state. The final section discusses the Mean Absolute Percentage Error (MAPE) achieved using the "cohort survival" method for all 50 states and the District of Columbia. The MAPE is calculated from the error measures generated by 13 independent projection series. Each series assumes a different final year of actual enrollment and high school graduate data beginning with 1974-75 and progressing sequentially through 1986-87.

Although WICHE's 1988 projection series provided projections of public and non-public high school graduates, this analysis focuses exclusively on the accuracy of WICHE's public high school graduate projections. Due to uncertainties about the accuracy of the non-public data reported to state education agencies, testing the accuracy of projections for non-public high school graduates is problematic. In most states where non-public enrollment and high school graduate data are available non-public schools report on a voluntary basis, thus the schools reporting data may vary from year to year. For this reason, this analysis is limited to WICHE's projections of public high school graduates.

Projection Accuracy

WICHE's high school graduate projections help planners analyze long-term trends in the size of the college-age population. As Figure 1 shows, WICHE's projections closely follow the actual trend in the size of the nation's high school graduating class. WICHE's 1988 projection series varies less than 1 percent from the actual number of graduates for 1988 and 1989, and 1.5 percent and 2.3 percent from the actual number of graduates for 1990 and 1991, respectively (see Table 1).

The WICHE projections are closer than the National Center for Education Statistics (NCES) projection series produced in 1989 in three out of the four years for which actual data are available for comparison[2] (see Table 1). The NCES projections also tend to vary more from the national trend than the WICHE projections (see Figure 1).

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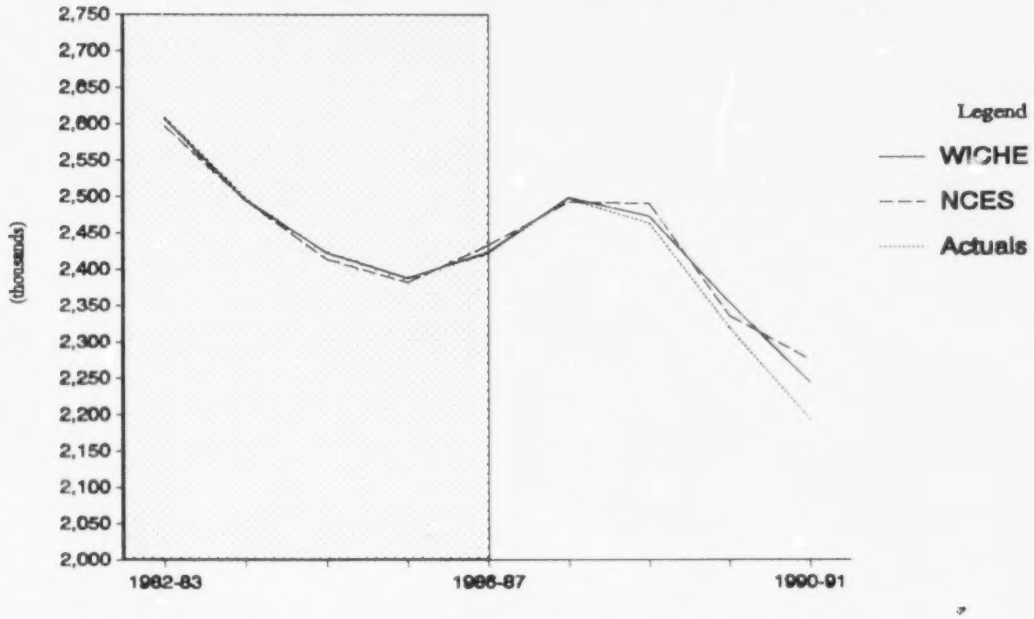
[1]The National Center for Education Statistics has published annual projections of high school graduates by state since 1989. The 1989 edition is used for comparison because it is based on actual data through 1986-87 and is therefore the most comparable to WICHE's 1988 projection series.

[2]The National Center for Education Statistics study includes both national and state-by-state high school graduate projections. Persons interested in comparing NCES's and WICHE's state level projections are encouraged to refer to the publications listed in the reference section of this report.

Figure 1

Public High School Graduate Projections--United States

1983-1987 (actuals), 1988-1991 (projected)



Source: Western Interstate Commission for Higher Education 1988 and National Center for Education Statistics 1989.

Table 1
Public High School Graduate Projections
United States, 1988 to 1991

	Actual	WICHE	Percent Variation from Actual	NCES	Percent Variation from Actual
1988	2,497,799	2,499,057	0.1	2,492,791	-0.2
1989	2,464,254	2,473,566	0.4	2,491,325	1.1
1990	2,320,205	2,354,896	1.5	2,337,111	0.7
1991	2,193,947	2,244,737	2.3	2,276,290	3.8

*Includes estimates for states from which actual data are not available or could not be made comparable with earlier years (1991-Massachusetts, Mississippi, Texas and Vermont; 1990 Massachusetts and Mississippi).

Source: Western Interstate Commission for Higher Education 1988 and National Center for Education Statistics 1989.

Table 3
Difference between WICHE Projections and Actual Public High School Graduates 1988 to 1991

	Percentage Error			
	1988	1989	1990	1991
Alabama	-6.0	-7.1	-7.2	-8.0
Alaska	4.6	9.2	8.3	4.9
Arizona	-1.0	0.2	-2.8	-1.2
Arkansas	-0.7	1.3	1.7	2.0
California	-1.5	-2.0	-2.4	-3.5
Colorado	-2.1	-1.9	1.5	0.5
Connecticut	0.2	-0.6	4.6	-3.1
Delaware	0.9	-1.6	2.4	0.2
District of Columbia	7.8	2.1	-1.7	3.5
Florida	-0.5	-0.4	3.6	-1.1
Georgia	-0.8	2.9	1.6	-0.6
Hawaii	-0.8	-2.1	3.5	1.9
Idaho	1.8	-1.2	-1.7	-4.4
Illinois	-0.7	-0.2	0.5	-1.6
Indiana	0.4	2.4	3.7	-0.2
Iowa	-0.2	0.4	-0.3	1.4
Kansas	-1.1	0.9	1.2	0.4
Kentucky	-0.8	0.1	-1.0	-1.1
Louisiana	-2.4	-0.9	3.8	6.6
Maine	0.2	11.6	3.4	2.0
Maryland	-0.6	-2.0	4.4	-3.5
Massachusetts	1.9	-0.2	--	--
Michigan	7.3	6.6	8.6	9.6
Minnesota	7.8	1.1	1.3	0.4
Mississippi	-2.8	-2.6	--	--
Missouri	0.2	1.9	4.3	1.7
Montana	-0.5	-1.3	1.4	-0.7
Nebraska	0.4	0.0	0.9	-1.2
Nevada	4.2	6.8	-0.1	-0.5
New Hampshire	0.8	1.0	1.3	-2.2
New Jersey	-0.9	-0.5	-0.5	-3.3
New Mexico	-1.7	0.8	6.7	1.8
New York	0.2	2.5	2.5	3.9
North Carolina	0.8	-1.0	1.2	0.4
North Dakota	-1.8	-1.2	-1.0	-0.2
Ohio	1.3	0.9	5.1	4.6
Oklahoma	1.4	0.7	0.6	1.2
Oregon	-0.7	-0.1	-0.3	-3.9
Pennsylvania	0.2	-0.4	1.4	0.6
Rhode Island	0.3	-0.4	3.6	-0.7
South Carolina	-0.7	-0.4	2.0	3.6
South Dakota	-0.2	1.9	1.7	2.1
Tennessee	-1.6	0.5	2.8	1.7
Texas	-1.4	0.4	1.4	--
Utah	2.9	1.5	1.2	1.9
Vermont	-1.8	-1.4	4.5	--
Virginia	0.0	0.5	1.4	0.5
Washington	-0.3	0.8	-0.3	0.0
West Virginia	0.3	-0.1	-0.7	-0.6
Wisconsin	-0.3	1.0	1.9	5.0
Wyoming	-0.1	1.0	1.2	1.5

-- indicates actual data are not available or could not be made comparable with earlier years.

Due to the increased variability of migration and other factors, projections are likely to vary more from actuals at the regional and state levels. WICHE's projections vary the most from the actuals in the Northcentral region, but are still within 2 to 3 percent of the actuals. In the other three regions, the WICHE projections vary 1 percent or less one year out (1988), and from less than 1 percent to 2 percent four years out (1991) (see Table 2).

A wider variation in projection accuracy is experienced at the state level. Projections for 1988 vary 1 percent or less for three-fifths of the states and the District of Columbia. Projections one year from the last year of actual data (1988) vary 7 percent or more in only three states (Michigan, Minnesota, and the District of Columbia). Four years into the projection series (1991), however, the projections still vary 1 percent or less in one-third of the states, and 2 percent or less in three-fifths of the states (see Table 3).

Table 2
Difference between WICHE's Projections and Acutal Public High School Graduates 1988 to 1991 by Region

	Northcentral	Northeast	South/ Southcentral	West
1988	1.8	0.2	-1.0	-0.8
1989	1.8	0.6	-0.2	-0.9
1990	3.4	2.0	1.2	-0.9
1991	2.7	0.4	0.1	-1.9

Test of the Projection Methodology

Comparing the accuracy of a single projection series with actual data is interesting, but does not accurately reflect the overall reliability of the methodology. The variation of a single projection series from the actual can be influenced by one-time occurrences or sudden changes in migration or other intervening factors. To achieve a more accurate measure of reliability it is necessary to standardize the error by averaging it over a number of independent projection series. The Mean Absolute Percentage Error (MAPE) is a measure commonly used to evaluate the reliability of demographic projection methods.

In order to test the reliability of the "cohort survival" method used to compute WICHE's high school graduate projections, 13 independent projection series for each of the 50 states and the District of Columbia were generated using this method. The Mean Absolute Percentage Errors (MAPE) for each state were calculated as follows: (1) each of the 13 projection series are based on a different final year of actual enrollment and high school graduate data beginning with 1974-75 and progressing sequentially through 1986-87; (2) absolute percentage errors were calculated for each projection series; and (3) the absolute percentage errors for each point out from the last year of actual data were averaged.

Table 4
Mean Absolute Percentage Error for High School Graduate Projections

	Lead Time			
	Year 1	Year 3	Year 5	Year 10
United States	**0.9**	**1.1**	**3.1**	**3.6**
Alabama	2.3	3.5	5.5	11.0
Alaska	6.2	10.1	10.4	14.8
Arizona	5.4	6.9	7.0	6.9
Arkansas	1.3	2.7	4.5	5.9
California	2.8	5.5	7.4	10.7
Colorado	1.4	2.7	3.2	2.9
Connecticut	1.0	2.3	3.7	14.1
Delaware	4.6	5.8	7.4	18.7
District of Columbia	4.0	5.0	7.0	13.8
Florida	1.4	3.9	5.1	9.2
Georgia	1.6	3.2	3.5	3.4
Hawaii	1.8	2.6	4.8	7.2
Idaho	2.4	2.6	3.0	7.0
Illinois	1.6	4.8	8.1	11.0
Indiana	1.9	3.2	4.3	3.0
Iowa	1.1	2.6	3.6	4.3
Kansas	1.2	3.2	5.3	7.8
Kentucky	1.8	4.1	5.3	9.0
Louisiana	1.7	3.5	5.7	17.2
Maine	1.3	3.8	5.8	7.4
Maryland	1.5	3.6	5.1	12.7
Massachusetts	0.8	1.6	2.4	4.7
Michigan	2.6	4.6	4.1	6.3
Minnesota	1.3	2.3	3.9	5.3
Mississippi	1.6	3.7	3.7	16.4
Missouri	1.0	3.2	4.2	3.9
Montana	1.6	2.8	3.3	1.6
Nebraska	1.0	2.1	3.1	3.2
Nevada	4.1	5.2	6.0	7.6
New Hampshire	1.8	3.8	5.5	11.9
New Jersey	1.0	2.0	3.3	5.4
New Mexico	1.8	2.8	3.5	1.9
New York	0.6	2.1	3.7	10.8
North Carolina	1.1	2.7	3.6	3.6
North Dakota	1.6	3.1	3.8	5.0
Ohio	2.6	5.5	7.7	9.3
Oklahoma	1.1	2.5	4.6	5.7
Oregon	1.4	2.8	4.3	3.5
Pennsylvania	0.9	2.6	3.5	4.8
Rhode Island	0.8	1.3	3.3	15.5
South Carolina	1.4	2.1	3.3	8.1
South Dakota	1.5	3.0	3.3	3.8
Tennessee	1.8	3.5	4.6	7.2
Texas	1.8	3.2	4.5	11.7
Utah	1.5	2.1	3.6	4.4
Vermont	1.6	3.3	4.2	2.9
Virginia	1.5	3.9	5.7	10.1
Washington	1.3	2.3	4.2	7.0
West Virginia	1.7	3.7	6.4	5.0
Wisconsin	1.2	4.3	6.4	11.8
Wyoming	1.5	2.8	5.3	28.3

The MAPEs for the nation are 1.3 percent one year from the last year of actual data; 2.2 percent three years out; 1.2 percent five years out; and 0.2 percent ten years out. MAPEs for individual state projections vary significantly, but some general observations can be made. The "cohort survival" method yields an MAPE of 2.0 or less in 80 percent or more of the states in year 1, and an MAPE of 5.0 or less in 60 percent of the states in year 5, and in at least one-third of the states by year 10. Table 4 displays the MAPEs for all states and the District of Columbia for one, three, five and 10 years from the last year of actual data.

Conclusion

This test of the methodology was conducted to provide users of the WICHE high school graduate projections with information on the accuracy of the projections. It also was conducted as a means for analyzing and evaluating the reliability of WICHE's projection methodology. The Mean Absolute Percentage Errors generated by this procedure are, in general, well within the expected range for the nation and the states for years 1 through 10. MAPEs exceeding ten percent in some states, however, are a concern. Variations in the reliability of the projections across states may be due, in part, to variations in the relative size of the state's high school graduate populations. A one percent error in Wyoming, for example, represents a variation of only 57 graduates. Moreover, since the projections are based on past trends, dramatic changes in migration, high school persistence, and other intervening factors also may partially explain the variation in MAPEs across states. In light of the results of this study, the errors in each state are being analyzed and possible improvements to the way in which projection ratios are calculated within the "cohort survival" method are being evaluated.

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